VITESSE

Feasibility of 1000-Base-T RPS Restart

Mandeep Chadha
Jim Barnette
Worayot Lertniphonphun

YOUR PARTNER FOR SUCCESS

Outline

VITESSE

- Experimental setup
- Timing re-acquisition experiment
- Cable temperature change experiment
- Possible 1000-Base-T restart mechanism

Experimental Setup

VITESSE

- Setup involved a Vitesse DUT PHY configured in slave mode
  - Link partner 1 was another Vitesse PHY evaluation board
  - Link partner 2 was a SmartBits Lan-3300A card
- Linked up 1000-Base-T PHY's operating over 100m worst-case Cat-5e cabling
- Froze adaptive filter elements excluding timing recovery on slave PHY
- Passed traffic at 100% utilization overnight without errors
- Similar tests were repeated on a master PHY with the same result
- This gives an initial indication of durability of adaptive filter state

Timing re-acquisition experiment

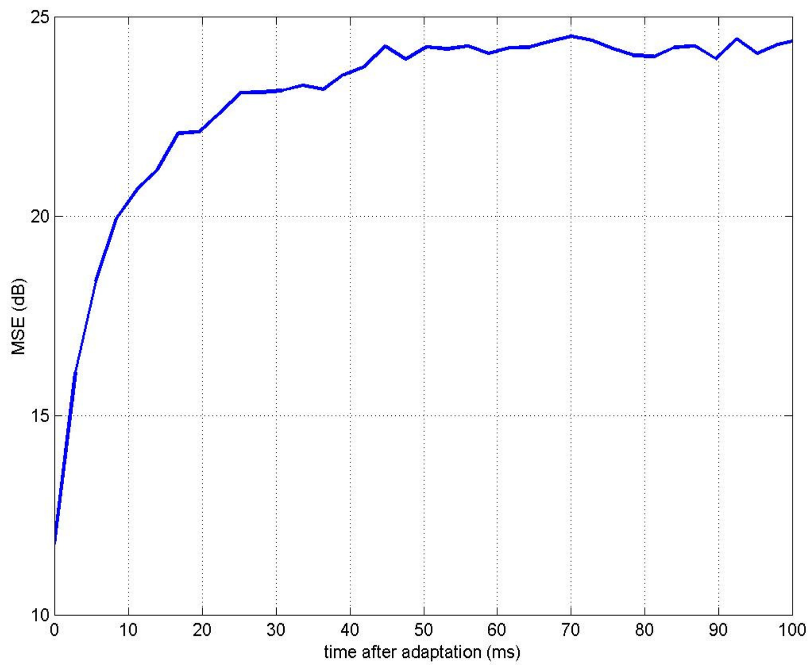
VITESSE

- Using the experimental setup with link partner 1:
  - A worst-case 100m cable was setup in the lab at room temperature
  - The 1000-Base-T link was brought up and the master link was forced
  - The slave PHY was allowed to train its adaptive filters
  - Internal adaptive filters were frozen on the slave
  - Then timing recovery was frozen on the slave and cyclic performance was observed
  - Timing recovery was re-enabled while performance was monitored
- Timing was reliably re-acquired by the slave in between 2.0 and 2.5 ms

Cable temperature change experiment

VITESSE

- Using the experimental setup with link partner 2:
  - A worst-case 100m cable was placed in an oven and heated to 70C
  - The 1000-Base-T link was brought up on cable at 70C
  - Internal adaptive filters were frozen on the slave
  - Cable was cooled to 20C
  - Adaptive filters were re-enabled while performance was monitored



1000-Base-T rapid restart in 2 phases

VITESSE

- Phase 1: Timing re-acquisition
  - May be accelerated by previously saved frequency offset estimate
  - Assume that at restart, the slave sees a random sampling phase from master
- Phase 2: Adaptive filter re-training
  - Previously trained equalizer coefficients should be a good starting point at restart
  - Echo/NEXT may have drifted due to intervening temperature change
  - Significant noise environment changes may lead to some retraining at restart

Phase 1: Timing re-acquisition

VITESSE

- Repeated tests in our lab on worst-case 100m cables suggests that timing re-acquisition needs between 2.0 and 2.5 ms
- Other vendors will need to run their own experiments, but we can estimate that a feasible goal is to reacquire timing within 5 ms
- Measurements were made only on 1000-Base-T, but there is little reason to expect 100-Base-TX timing recovery to differ in DSP-based transceivers

Phase 2: Adaptive filter re-training

VITESSE

- Based on results of cable temperature change test, need to allow for up to 40 ms to recover performance
- Further tests were performed in the lab using worst case noise injections added to 100m worst-case cable setup and times as long as 100 ms were needed to recover optimal performance
- So, we recommend that a variable time be allowed for re-training and that a signaling mechanism be defined to indicate when 1e-10 BER performance level has been achieved
- A worst-case timer should also be specified so that we know when to give up on link re-training and re-start auto-negotiation

Possible 2-phase 1000-BT restart mechanism

VITESSE

- Master begins by transmitting idles with local receiver status low
- Slave re-acquires phase lock and begins transmitting idles with local receiver status low within TBD ms
- When slave predicted performance meets 1e-10 BER, it sets local receiver status high
- Master detects signal from slave and re-acquires phase lock
- When master predicted performance meets 1e-10 BER, it sets local receiver status high
- Link is considered restored when both Master and Slave see both local & remote receiver status high
- Specify a maximum time for receiver status to be asserted else restart auto-negotiation